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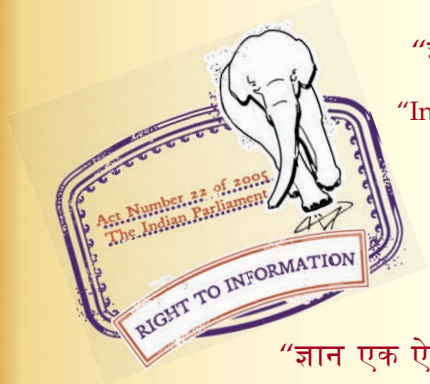

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Indian Standard

PRESENTATION OF STATISTICAL DATA

PART II DIAGRAMMATIC REPRESENTATION OF DATA

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PRESENTATION OF STATISTICAL DATA

PART II DIAGRAMMATIC REPRESENTATION OF DATA

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Indian Standard

PRESENTATION OF STATISTICAL DATA

PART II DIAGRAMMATIC REPRESENTATION OF DATA

0. FOREWORD

0.1 This Indian Standard (Part II) was adopted by the Indian Standards Institution on 10 February 1975, after the draft finalized by the Quality Control and Industrial Statistics Sectional Committee had been approved by the Executive Committee.

0.2 Part I of this standard, dealing with tabulation and summarization of data, had been prepared with a view to assisting in drawing valid inferences from a large amount of data. However, sometimes the salient features of the data may not be quite evident to the user when these are presented in a tabular form. Besides, some of the actual pattern of the data, specially pertaining to a time series type of observations are lost in the condensation and tabulation. On the other hand, graphs and charts facilitate quick understanding of the contents of the data, bring out fluctuations, inter-relationships and other essential details more prominently.

0.3 The graphical representation of data has very wide use in practically all spheres of human activity, be it administrative, trade and commerce, education or any other scientific endeavour. However, depending on the situation a particular type of graphical or pictorial representation may be more effective than others. With this end in view, some of the most important types of diagrammatic representation of data are dealt with in this standard. The user may suitably select them or their combinations for his purpose.

---

1. SCOPE

1.1 This standard (Part II) deals with the diagrammatic representation of data in the form of line graphs, bar charts, pie charts, symbol charts and statistical maps. The colouring technique is outside the scope of this standard.

1.2 The other two important forms of diagrammatic representation, namely, histograms and statistical curves, which are more relevant in the context of summarization of data, have been dealt with in Part I of the standard.

2. VARIOUS FORMS OF DIAGRAMMATIC REPRESENTATION

2.1 Line Graphs — This category may be subdivided into the following four types:

a) Single line graph,
b) Multi-line graph,
c) Balance graph, and
d) Maxima and minima graph.

2.1.1 *Single Line Graph* — This form of graphical representation is very often used for the time series data. Using the time factor as the abscissa and the value of the variable as the ordinate a series of observations are plotted in the chronological order. The line obtained by joining the consecutive point is called the line graph. It brings out the fluctuations as well the general trend of the variable effectively. As an illustration, the line graph for the data on production of iron ore in India (excluding production from Goa) during the period 1951-1966 is shown in Table 1 and Fig. 1. Line graphs can also be used for studying the relationship between two variables when one is dependent on the other.

TABLE 1 PRODUCTION OF IRON ORE IN INDIA DURING 1951-66

YEAR	QUANTITY (in million tonnes)	YEAR	QUANTITY (in million tonnes)
1951	3·72	1959	7·98
1952	3·99	1960	10·08
1953	3·92	1961	12·31
1954	4·38	1962	13·54
1955	4·75	1963	15·09
1956	4·98	1964	15·43
1957	5·17	1965	17·15
1958	6·13	1966	20·06

2.1.2 *Multi-line Graph* — When the line graphs of two or more variables are shown in the same chart, it is called the multi-line graph. This gives a comparative picture of the trends of several variables. Variables of the same kind are to be used while drawing the multi-line graphs. To distinguish, identify and bring out the relative importance of different variables, a bold continuous line may be used for the most important variable, a thin line for the next important variable, a broken line for the third variable and a dotted line for the remaining variable and so on. The data in Table 2 on the monthly quantity index of mineral production during 1970 have been used to illustrate this graph at Fig. 2.

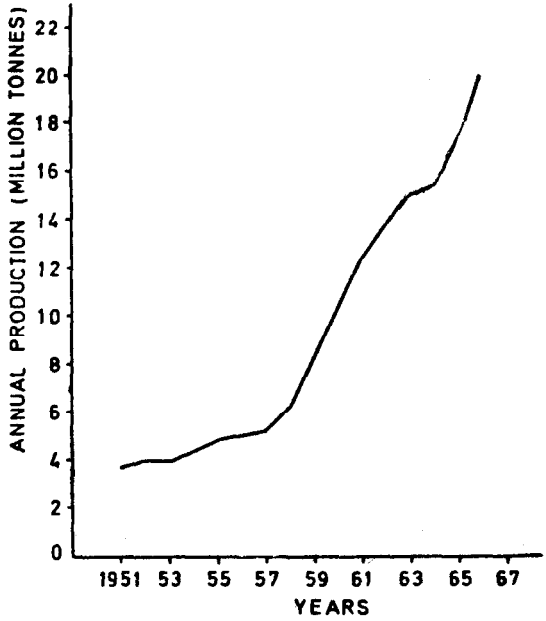

FIG. 1 PRODUCTION OF IRON ORE IN INDIA DURING 1951—66

TABLE 2 QUANTITY INDEX OF MINERAL PRODUCTION DURING 1970

(Base year 1960=100)

(*Clause* 2·1·2)

PERIOD		ALL MINERALS	COAL MINING INCLUDING LIGNITE	METAL MINING	NON-METALLIC MINING
1970	Jan	182	161	146	191
	Feb	175	153	149	190
	Mar	178	155	152	204
	Apr	179	160	149	190
	May	170	148	137	182
	Jun	163	146	122	165
	Jul	164	148	121	156
	Aug	154	136	117	144
	Sep	155	134	128	148
	Oct	166	139	152	158
	Nov	163	136	152	164
	Dec	182	151	172	196

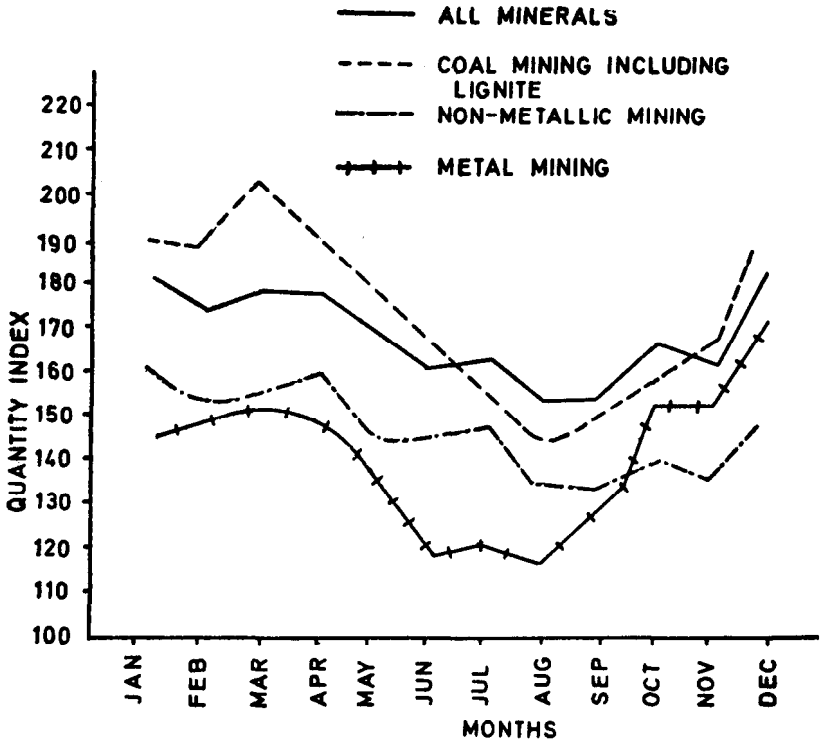

FIG. 2 QUANTITY INDEX OF MINERAL PRODUCTION DURING 1970
(Base Year 1960 = 100)

2.1.3 *Balance Graph* — The line graphs of a pair of associated variables like income and expenditure, imports and exports, etc, are drawn to bring out the degree of balance between the two. The areas bounded by the two lines are shaded in this graph. Favourable and unfavourable areas are shown in two distinct shades. Alternatively, the positive and negative differences between the two variables may be treated as a single variable and plotted as a single line graph, the positive values being shown above the line and the negative values below the line in opposite directions. This graph is illustrated with the data of imports and exports of Indian merchandise to UK for the period of 1955-56 to 1973-74 as given in Table 3. The resulting balance graph is shown in Fig. 3.

TABLE 3 IMPORTS AND EXPORTS OF INDIAN MERCHANDISE TO UK

(Clause 2.1.3)

(In crores of rupees)

YEAR	IMPORTS	EXPORTS
1955-56	199·8	164·4
1956-57	213·0	180·8
1957-58	221·0	161·4
1958-59	158·6	164·2
1959-60	194·3	178·8
1960-61	217·2	170·7
1961-62	200·2	159·7
1962-63	185·6	162·2
1963-64	171·5	163·0
1964-65	163·6	166·4
1965-66	150·1	144·8
1966-67	165·5	202·0
1967-68	162·6	228·5
1968-69	127·5	200·8
1969-70	100·4	164·2
1970-71	126·7	169·9
1971-72	220·8	168·1
1972-73	237·2	171·8
1973-74	244·8	258·0

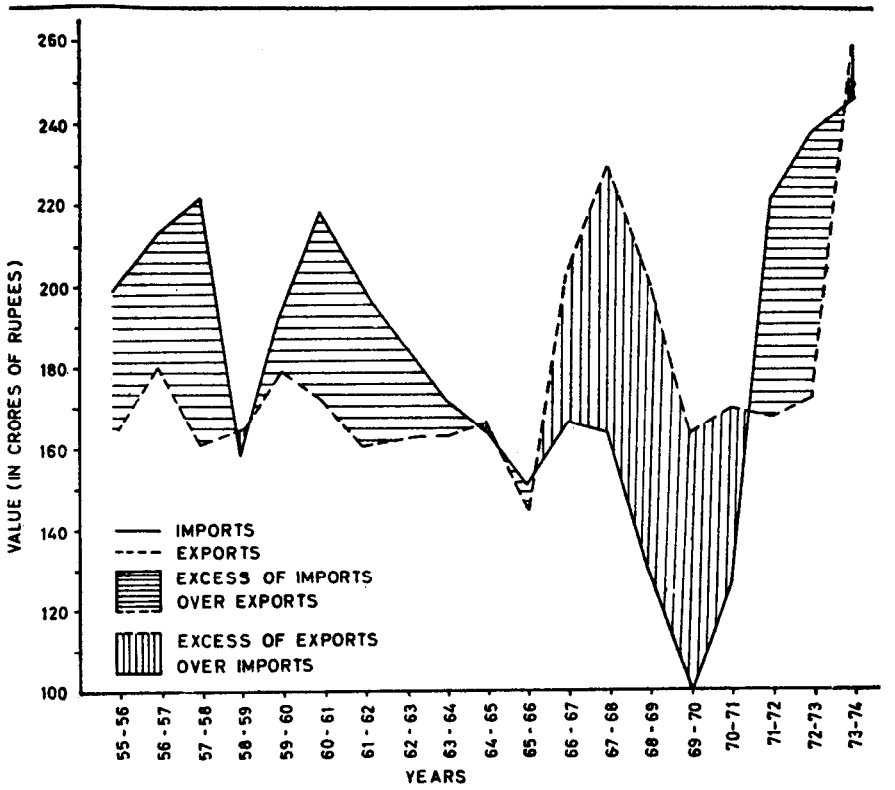

FIG. 3 VALUE OF IMPORTS AND EXPORTS OF INDIAN MERCHANDISE TO UK

2.1.4 *Maxima and Minima Graph* — The highest and lowest values of the variables for each time period are plotted and connected by bold vertical lines. The average values of the variable are then connected by a line graph. Such a graph brings out the short term fluctuations and help to assess the general trend more objectively. In Table 4 are given the spot prices of standard gold prevailing in the Bombay market for 15 months from August 1972 to October 1973. The highest, lowest and average prices are tabulated separately and the resulting maxima and minima graph is given in Fig. 4.

TABLE 4 SPOT PRICES OF STANDARD GOLD (PER 10 GRAMS) IN THE BOMBAY MARKET

Period		Highest	Lowest	Average
		Rs	Rs	Rs
1972	August	255	234	239
	September	256	250	252
	October	250	241	247
	November	252	241	245
	December	250	242	246
1973	January	254	242	248
	February	288	252	265
	March	283	266	273
	April	332	279	307
	May	341	319	328
	June	334	321	326
	July	348	324	333
	August	400	342	360
	September	362	353	357
	October	360	350	356

2.2 Bar Charts — This category may be further subdivided into the following five types :

a) Simple bar chart,
b) Multi-bar chart,
c) Component bar chart,
d) Component trend chart, and
e) Pyramid bar chart.

2.2.1 *Simple Bar Chart* — This is used to represent the trend of a single variable by bars, the heights of which are proportional to the value of the variable. The width of the bars is kept constant. The bar width should not, however, be too thick or too thin and should be drawn at regular short intervals. As a working rule, the intervals need not be more than twice the width of the bars. The number of time periods/categories, if represented by simple bar charts, should preferably be below 15. The bars may be thickly shaded so as to render the visual comparison of the values more prominent and easier than in the case of line graph. Table 5 represents the consumption of electricity in the selected industries for the year 1967-68 and data is also represented in the form of simple bar charts in Fig. 5.

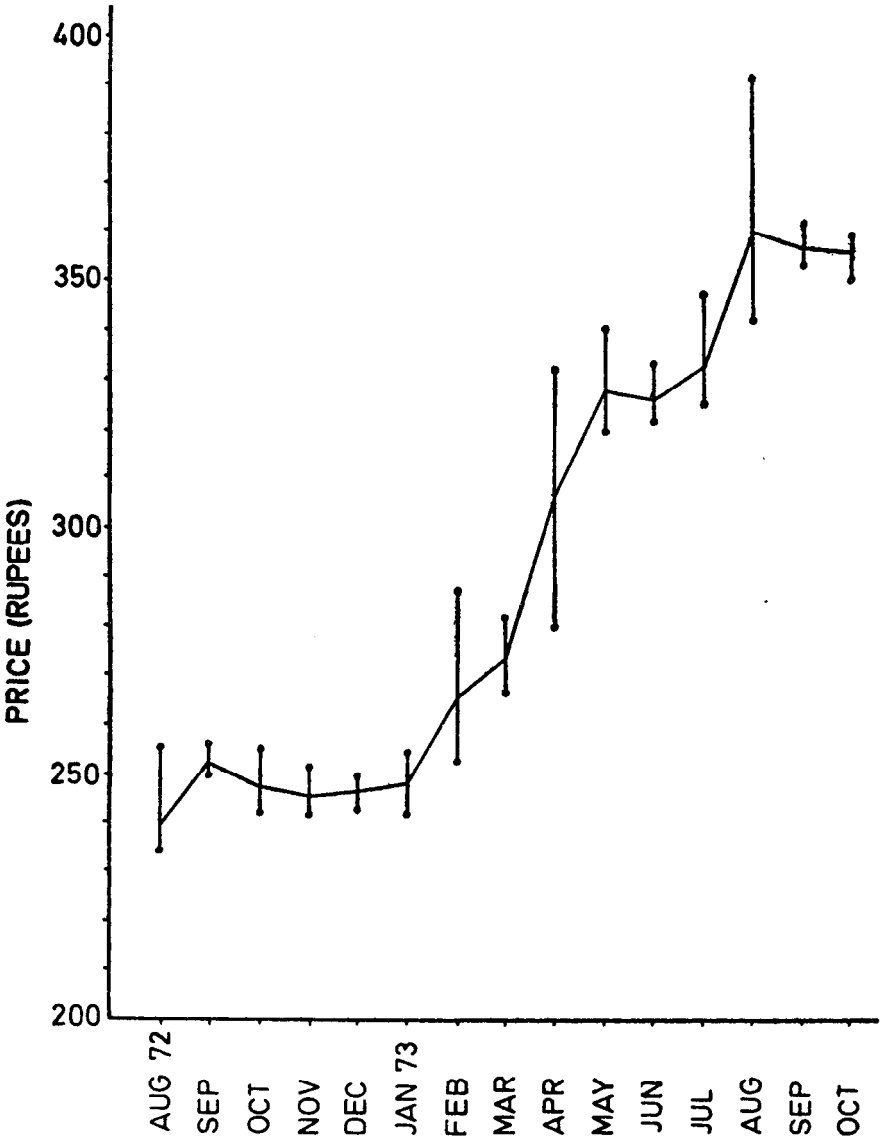

FIG. 4 HIGHEST, LOWEST AND AVERAGE MONTHLY PRICES PER 10 GRAMS OF GOLD IN BOMBAY FOR THE PERIOD AUGUST 1972 TO OCTOBER 1973

TABLE 5 CONSUMPTION OF ELECTRICITY IN SELECTED INDUSTRIES IN 1967-68

(*Clause* 2.2.1)

INDUSTRIES	CONSUMPTION (Million kWh)
Silk	445
Colliery	592
Jute	692
Chemicals	751
Paper	777
Cement	1 121
Fertilizers	1 981
Aluminium	2 098
Iron and steel	2 677
Cotton textiles	2 948

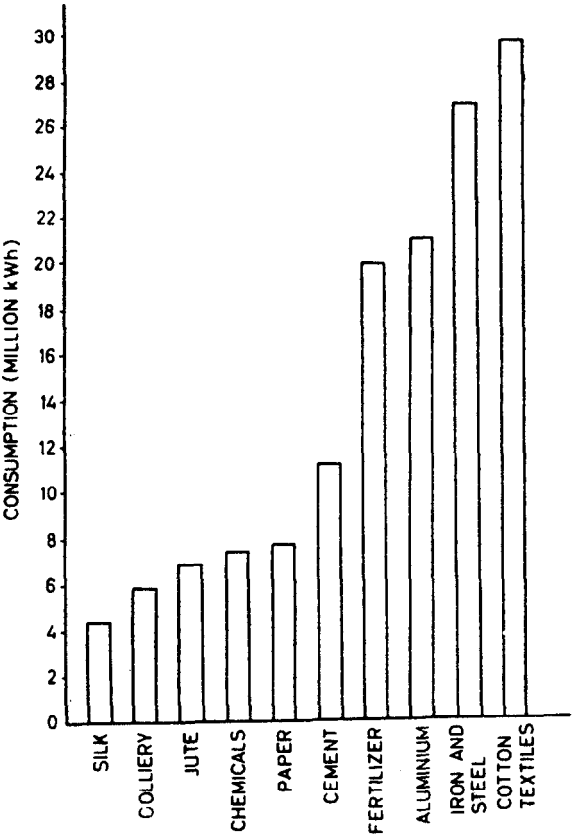

FIG. 5 CONSUMPTION OF ELECTRICITY IN SELECTED INDUSTRIES IN 1967-68

2.2.2 *Multi-bar Chart* — In this chart more than one variable is represented by the bars. The bars have the same breadth for all the variables and time periods. Different colours or shading patterns may be used to distinguish between the variables. For each time period the bars are juxtaposed to form a cluster with a space in between the clusters for different time periods. The sequence of the variables within a cluster remains the same as in the case of first cluster. For the first cluster, the bars are arranged either in the ascending or descending order of their heights. It is not convenient to present more than four or five variables in this chart. Multi-bar charts bring out the trend of the variables as well as their relative importance much more effectively. The data on production of selected minerals and ores in India, as given in Table 6, is drawn in the form of a multi-bar chart in Fig. 6.

TABLE 6 PRODUCTION OF SELECTED MINERALS AND ORES IN INDIA

(*Production Value in '000 Rs*)

YEAR	IRON ORE	COPPER ORE	MANGANESE	GOLD
1951	20 953	19 400	72 000	67 530
1956	39 863	28 981	129 757	57 673
1961	89 211	22 981	75 831	59 103
1966	175 969	25 378	90 048	44 979

2.2.3 *Component Bar Chart* — When the value of a variable is composed of several parts, the bar representing it will be divided into component parts which may be distinguished by different colours or shading patterns. The sequence of the components should remain the same in all the bars and the larger components should occupy the lower portion of the bars. The component bar chart is depicted in the same way as a simple bar chart in other respects, namely, width of the bars, space in between the bars and the number of bars. This chart brings out the overall trend as well as the inter-relationship between the component variables and their trends. Table 7 provides an illustration of this chart which is given in Fig. 7.

2.2.3.1 For making the comparison between the various segments of the component bar charts more meaningful, it is sometimes advantageous to represent the data in terms of percentages. The data given in Table 7 is given in terms of percentages in Table 8 and represented as component bar chart in Fig. 8.

2.2.4 *Component Trend Chart* — In this chart the mid-points of upper widths of the bars corresponding to each component are plotted about the time periods and joined together to give a component line graph for each component. If the points between the two consecutive component lines are shaded differently, we get the component trend chart. The component trend chart depicting the data given in Table 7 is given in Fig. 9.

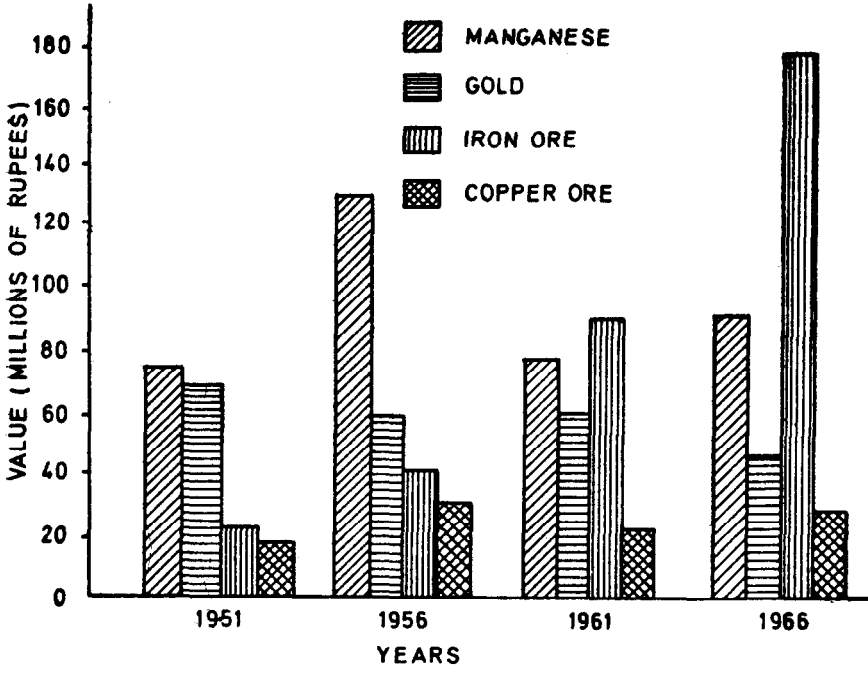

FIG. 6 PRODUCTION OF SELECTED MINERALS AND ORES IN INDIA

TABLE 7 PRODUCTION OF COTTON CLOTH (MILLS SECTION)

(*Clause* 2.2.3)

(*in million metres*)

YEAR	COARSE	MEDIUM	FINE AND SUPERFINE	TOTAL
1951	332·4	1 902·8	1 492·2	3 727·4
1956	657·1	3 471·6	723·6	4 852·3
1961	790·2	3 514·0	397·3	4 701·5
1962	760·8	3 350·2	449·3	4 560·3
1963	809·8	3 128·9	484·2	4 422·9
1964	868·5	3 283·2	501·8	4 653·5
1965	802·6	3 244·4	540·4	4 587·4
1966	719·6	2 992·4	526·9	4 238·9
1967	682·8	2 912·2	502·5	4 097·5
1968	708·9	3 096·5	560·8	4 366·2
1969	608·9	3 059·5	500·6	4 169·0

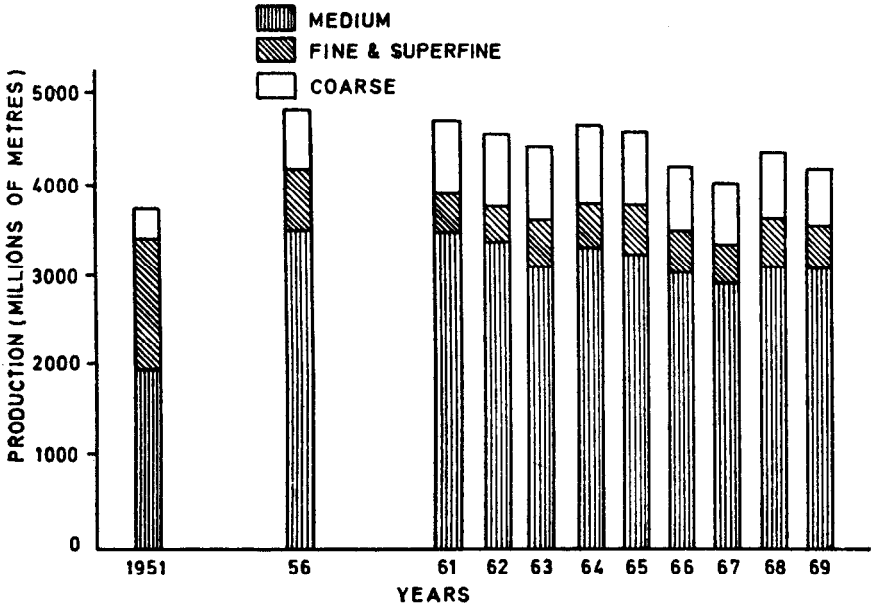

FIG. 7 PRODUCTION OF COTTON CLOTH (MILLS SECTION)

TABLE 8 PERCENTAGE PRODUCTION OF DIFFERENT VARIETIES OF COTTON CLOTH (MILLS SECTION)

(*Clause* 2.2.3.1)

YEAR	PERCENTAGE PRODUCTION OF			TOTAL
	Coarse	Medium	Fine and Superfine	
1951	8·9	51·0	40·0	99·9
1956	13·5	71·5	14·9	99·9
1961	16·8	74·7	8·5	100·0
1962	16·7	73·5	9·8	100·0
1963	18·3	70·7	10·9	99·9
1964	18·7	70·6	10·7	100·0
1965	17·5	70·7	11·8	100·0
1966	17·0	70·6	12·4	100·0
1967	16·7	71·1	12·2	100·0
1968	16·2	70·9	12·8	99·9
1969	14·6	73·4	12·0	100·0

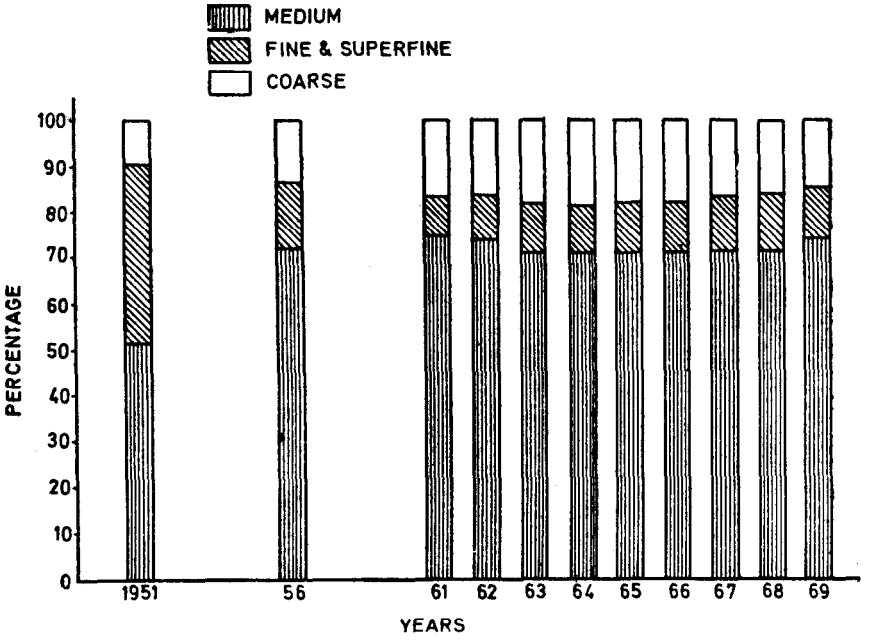

FIG. 8 PERCENTAGE PRODUCTION OF DIFFERENT VARIETIES OF CLOTH

2.2.5 *Pyramid Bar Chart* — If the values of the components corresponding to two attributes of opposite or related nature are entered one below the other with a narrow vertical space at the centre and shaded bars are drawn horizontally on either side with lines proportional to the values of the components in diminishing order upwards, the resulting chart will resemble to a pyramid in appearance. Such bar chart brings out an easy comparison and are extensively used for depicting information such as males and females in different regions, export and imports from different ports and so on. In Table 9, the gross weight of cargo handled at six major ports of India during 1966-67 are given and the resulting pyramid chart is given in Fig. 10.

2.3 Pie Chart — When the values of the components of a variable or their relative contributions to the total are of interest, they may be represented by the sectors of a circle while the whole circle or the pie represents the total value of the variable. The relative contribution is usually indicated by the percentage distribution. The sectors representing the components usually shown in descending order of their contribution, may be easily drawn with the help of a protractor, the angles being obtained by multiplying the percentages of the components by 3·6 or by multiplying the ratios of the values of the components to the total value by 360. In such a representation, the

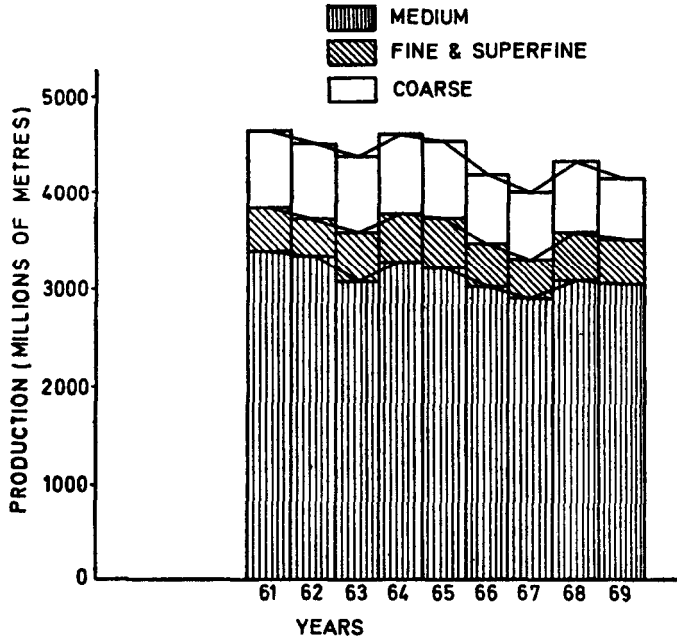

FIG. 9 PRODUCTION OF COTTON CLOTH

TABLE 9 GROSS WEIGHT OF CARGO HANDLED AT SIX MAJOR PORTS DURING 1966-67

(*Clause* 2.2.5)

PORT	1966-67	
	Imports (in million tonnes)	Exports (in million tonnes)
Calcutta	5 792	4 212
Bombay	13 227	5 039
Madras	3 868	1 988
Vishakhapatnam	2 227	3 712
Cochin	3 072	667
Kandla	2 424	238
Total	30 610	15 956

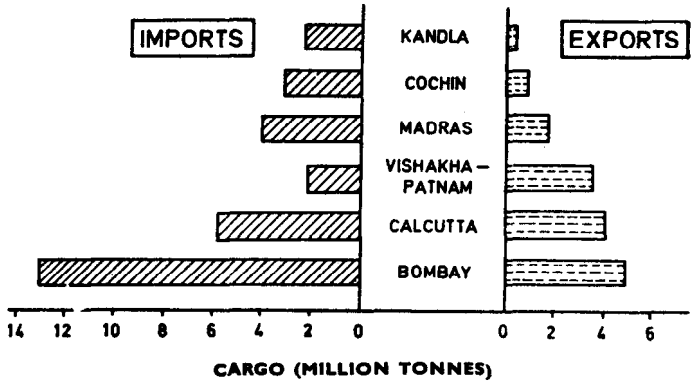

FIG. 10 GROSS WEIGHT OF CARGO HANDLED AT MAJOR PORTS

residual components may be indicated by the terms 'others', 'unclassified', 'miscellaneous' or 'not known' and shown last even though its share may be large.

2.3.1 A circle of convenient size is first drawn and a radius is drawn horizontally to the right of the centre as the starting point. The protractor is then placed on this radius with its centre coinciding with the centre of the circle. The angle of the first component is drawn for the sector indicating the first component. Then the protractor is placed on the second radius bounding the first sector as before and the second angle marked to obtain the second sector. The procedure is continued till the last component. If the contribution of the biggest sector exceeds 50%, the angle for this sector may be obtained by drawing the sector for the remaining contribution in the clockwise direction. Small sectors with less than three degrees may be lumped with the residual component. The number of components may thus be reduced to 5 or 6 by suitable grouping of the components.

2.3.2 Shades of decreasing intensity may be used to distinguish the component sectors. Brief description of the components together with actuals or percentages may be entered readable from left to right in small strips of space inside the sectors.

2.3.3 Pie charts may also be used for two or three time periods, regions or attributes having the same components for comparison purpose by drawing circles proportional in area to the values of the total. In such cases if R is taken to be the radius of the biggest circle corresponding to the largest total (T_{max}), the radius r of another circle is given by:

$$r = R\sqrt{\frac{T}{T_{max}}}$$ where T is the corresponding total.

2.3.4 The pie charts in Fig. 11 represent the data on input value for three different industries shown in Table 10.

2.3.5 Sometimes the components of a variable are also shown as fragments of a rectangle. Such representations are more common in the illustration of financial allocations wherein the picture of currency note is made use of. Figure 12 depicts the distribution of expenditure of an undertaking for the year 1972-73.

TABLE 10 INPUT VALUE FOR THREE INDUSTRIES DURING THE YEAR 1965

(*Clause* 2.3.4)

Sl No.	Item	Value in Rupees		
		Refractories	Tiles	Sanitary Ware and White Ware
i)	Fuel, electricity, lubricants, etc, consumed	13 652 440	13 939 099	5 090 143
ii)	Materials consumed	45 314 934	16 254 080	11 203 401
iii)	Work done by other concerns	820 678	2 624 635	302 670
iv)	Purchase value of goods sold in the same condition as purchased	1 494 313	241 153	437 364
v)	Depreciation	9 822 032	3 963 001	2 405 761
vi)	Others	7 127 576	2 202 640	1 475 851
	Total	78 231 973	39 224 608	20 915 190

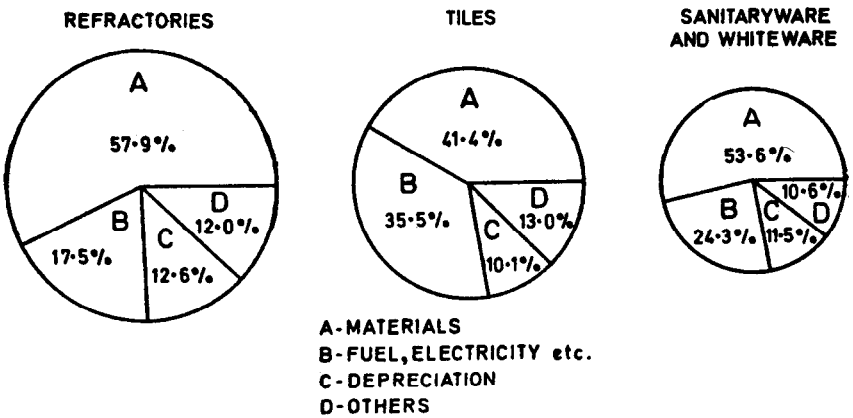

FIG. 11 PIE CHARTS ON INPUT PATTERNS OF THREE SELECTED INDUSTRIES

2.4 Symbol Chart — In this chart, a symbol indicative of the subject matter of the data is used as a unit of quantity, for example, a telephone representing 1 000 telephones produced in a year or a sewing machine representing 100 sewing machines manufactured in a year. There will be as many telephones shown in the chart for a particular year as many thousand telephones produced. This chart is also known as pictorial chart. In Table 11 is given the production of electric fans in India during 1956 to 1969 and the same is represented in Fig. 13.

TABLE 11 PRODUCTION OF ELECTRIC FANS IN INDIA DURING 1956 TO 1969

Year	Production ('000)
1956	338
1961	1 074
1962	1 130
1963	1 139
1964	1 085
1965	1 448
1966	1 289
1967	1 382
1968	1 468
1969	1 557

2.4.1 Because of the visual display and easy comprehension, symbol charts have a very wide range of application especially in fields like vital statistics. Table 12 gives the Decennial Growth of Population from 1901 to 1971 as obtained from successive census. The data when represented symbolically as in Fig. 14 brings out more clearly the extent of growth of the population.

TABLE 12 DECENNIAL GROWTH OF POPULATION 1901 TO 1971

Census Year	Population
1901	238 337 313
1911	252 005 470
1921	251 239 492
1931	278 867 430
1941	318 539 060
1951	360 950 365
1961	439 072 582
1971	547 949 809

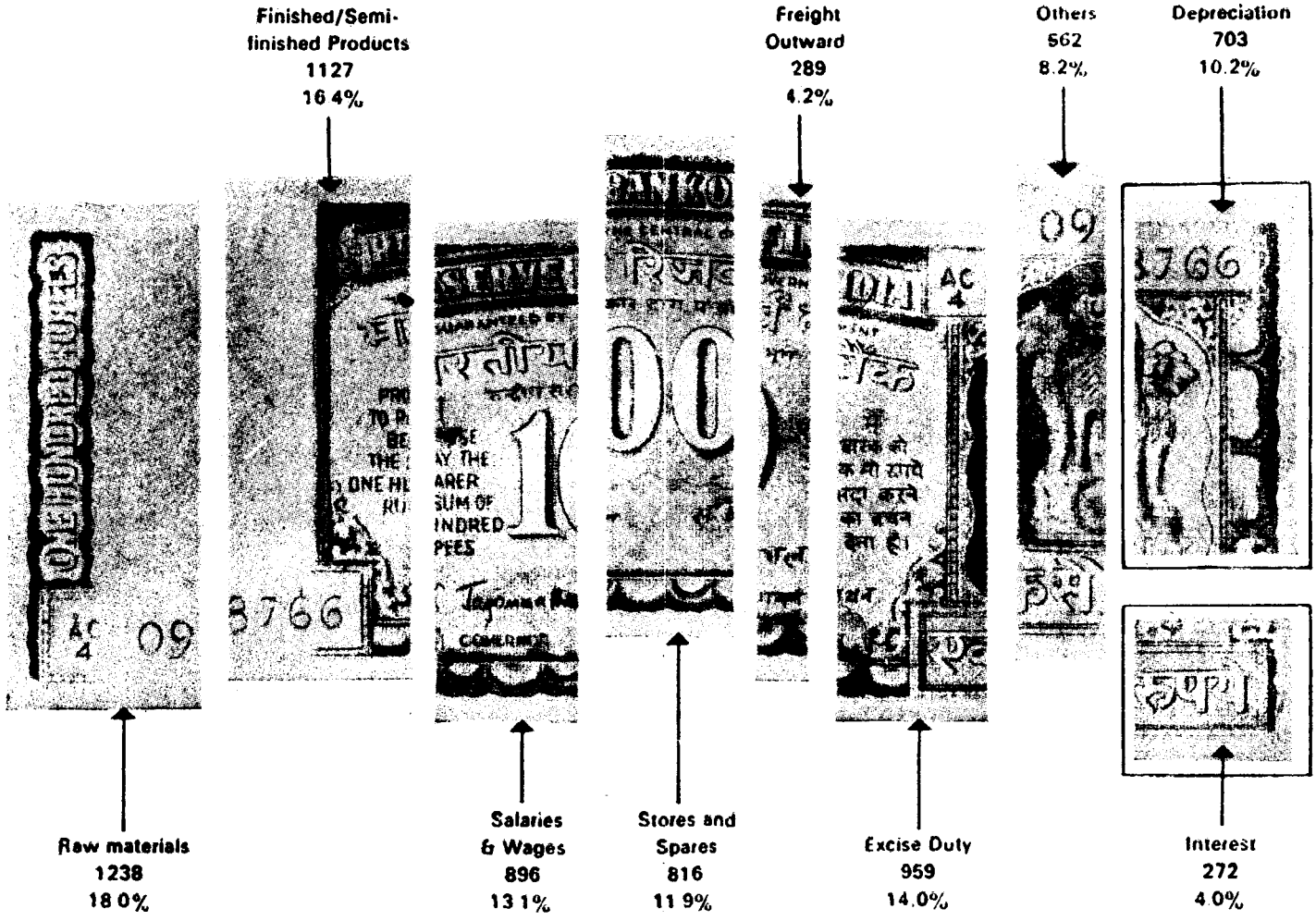

FIG. 12 DISTRIBUTION OF EXPENDITURE (MILLION RUPEES) OF AN UNDERTAKING FOR 1972-73

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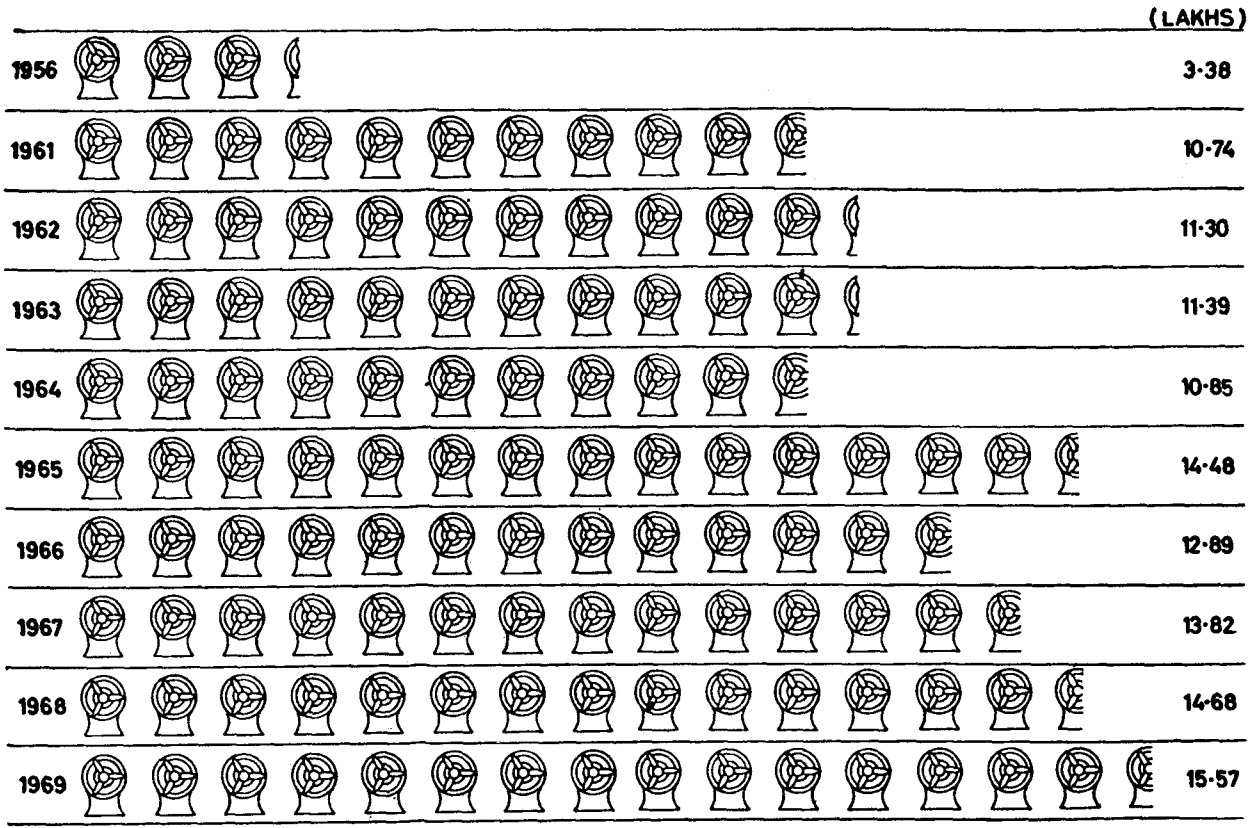
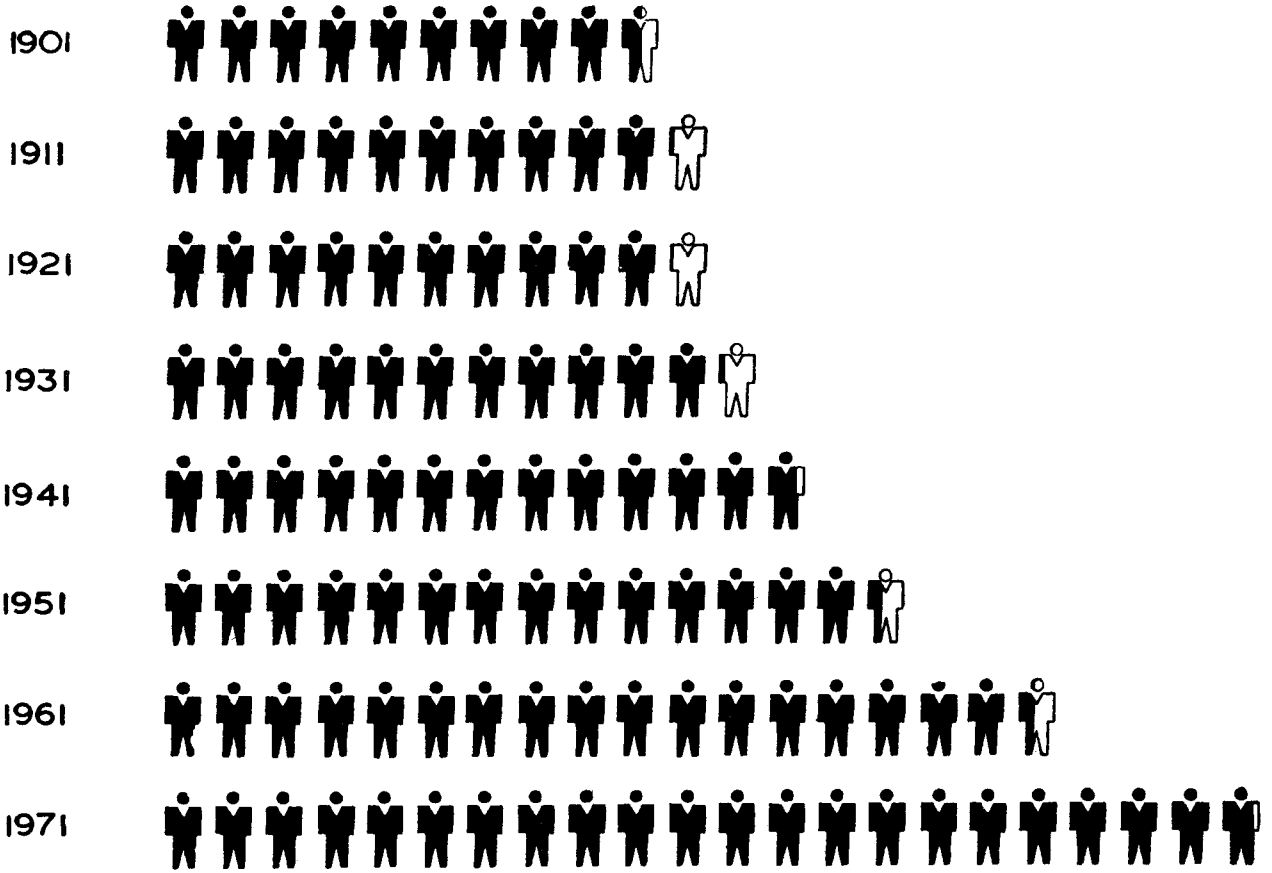


NOTE — Each symbol represents 100 000 fans.

FIG. 13 PRODUCTION OF ELECTRIC FANS IN INDIA DURING 1956 TO 1969



NOTE — Each symbol represents 25 million persons.

FIG. 14 DECENNIAL GROWTH OF POPULATION OF INDIA

2.5 Statistical Maps — Statewise or regionwise statistics in a particular subject or a number of subjects and their relative importance are effectively conveyed through statistical maps. The quantitative importance of each state/region is indicated by appropriate size of a single symbol or a number of symbols plotted on the map. Sometimes it is also possible to show the quantities pertaining to different regions by shades or colours. Up to four items or subjects of information can be conveniently presented in a single statistical map. Table 13 gives two items of information, namely, the number of the operative licences under the ISI Certification Marks as on 31 March 1974 and the income accruing (in lakhs of rupees) for the year 1973-74. For the operation of the ISI Certification Marks Scheme, the entire area of the country has been divided into eight regions administered by the Head-quarters and branch offices located in different places. The information contained in Table 12 is depicted in a statistical map in Fig. 15.

TABLE 13 NUMBER OF LICENCES AND INCOME FROM ISI CERTIFICATION MARKS SCHEME

Region	Operative Licences as on 31.3.74	Income for 1973-74 (Rs in lakhs)
Ahmedabad	127	3·0
Bangalore	137	2·3
Bombay	419	9·3
Calcutta	691	18·8
Delhi	393	8·1
Hyderabad	61	1·7
Kanpur	104	1·7
Madras	292	7·0
	2 224	51·9

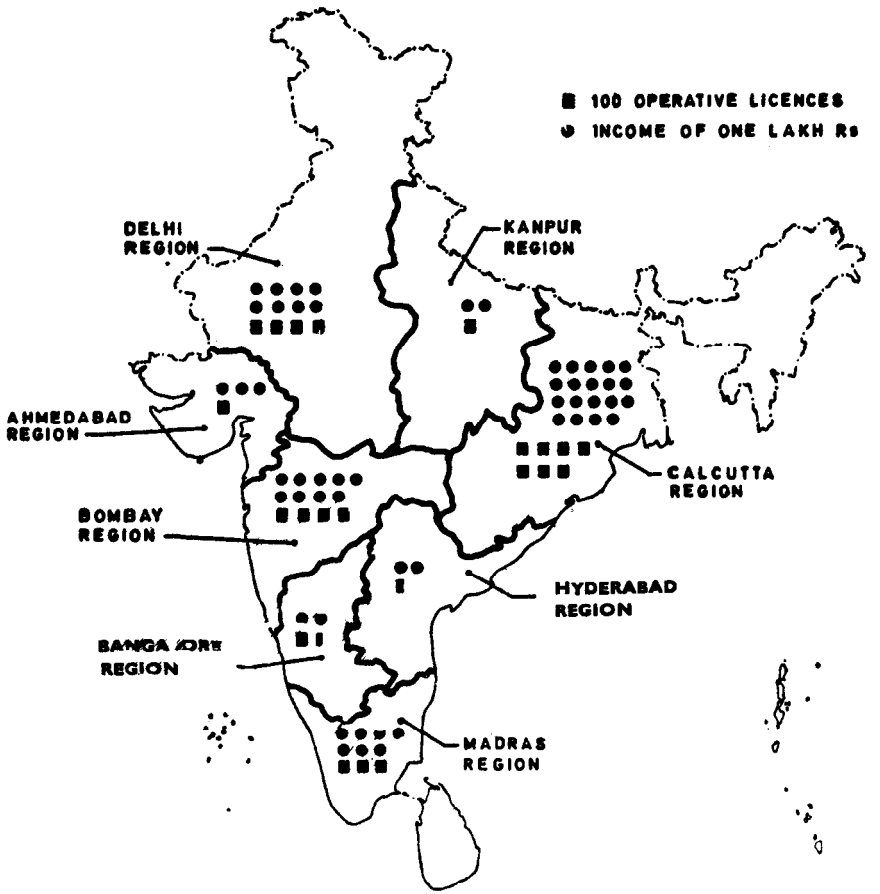


FIG. 15 STATISTICAL MAP SHOWING NUMBER OF OPERATIVE LICENCES AS ON 31 MARCH 1974 AND INCOME FROM CERTIFICATION MARKS FOR 1973-74 FOR DIFFERENT REGIONS

The territorial waters of India extend into the sea to a distance of twelve nautical miles measured from the appropriate base line.

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Plot No. 62-63, Unit VI, Ganga Nagar, BHUBANESHWAR 751001	40 36 27
Kalaikathir Buildings, 670 Avinashi Road, COIMBATORE 641037	21 01 41
Plot No. 43, Sector 16 A, Mathura Road, FARIDABAD 121001	8-28 88 01
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53/5 Ward No. 29, R. G. Barua Road, 5th By-lane, GUWAHATI 781003	54 11 37
5-8-58C, L. N. Gupta Marg, Nampally Station Road, HYDERABAD 500001	20 10 83
E-52, Chitaranjan Marg, C-Scheme, JAIPUR 302001	37 29 25
117/418 B, Sarvodaya Nagar, KANPUR 208005	21 68 76
Seth Bhawan, 2nd Floor, Behind Leela Cinema, Naval Kishore Road, LUCKNOW 226001	23 89 23
Patliputra Industrial Estate, PATNA 800013	26 23 05
T. C. No. 14/1421, University P. O. Palayam, THIRUVANANTHAPURAM 695034	6 21 17
NIT Building, Second Floor, Gokulpat Market, NAGPUR 440010	52 51 71
Institution of Engineers (India) Building, 1332 Shivaji Nagar, PUNE 411005	32 36 35

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